the subject of garbage-cremation we note that the crematory at Milwaukee has been complained of as a nuisance, the odors from it being a cause of great annoyance.

COLOR-AUDITION. — Mr. J. A. Maloney, otacoustician, of Washington, D.C., communicates to the *New York Medical Journal* the results of some experiments which he has recently made with reference to the conductivity of sound-vibration by the bones of the skull. For this purpose the bone was clamped in a standard which was rigidly affixed to a base of iron weighing sixteen pounds. At one end of the bone was placed in light contact a button suspended upon a rod having a curved projection at its top to allow the button to swing clear of its support. The other end of the bone was gently struck with a small hard-rubber mallet, and the space through which the button was projected noted. The results upon different bones were as follows: frontal, very hard blow, slight disturbance of ball, without projection; occipital, the same; parietal, the same; ethmoid, less than the former; sphenoid, a very slight tap on one great wing gave great projection from the other wing, and scratching with or rolling of the mallet over the surface of one wing caused the button impinging upon the other to be agitated. The sphenoid was then made to communicate its vibrations to the diaphragm of a microphone in electric circuit with a telephone-receiver. In this test a very fine thread of silk, held at one end, was drawn lightly over the free wing, and the same could be heard distinctly in the receiving-telephone. Breathing gently through a tube against the wing would be heard in the receiver. The temporal bone was then substituted for the sphenoid; and the only point which gave results similar to that of the sphenoid was when the two tests were made upon that portion of the petrous or pyramidal process known as the jugular fossa. Mr. Maloney asks, May not color-audition, in view of the readiness with which the sphenoid bone takes up and delivers vibrations, be due to mechanical stimulation of the optic nerve by impingement of the same upon the sphenoid bone in its passage through the optic foramen? The phenomenon of color-audition was first brought to the attention of the scientific world by Dr. Nussbaumer of Vienna, who, when a child, was engaged with his brother one day in striking a fork against a glass to hear the ring, when he discovered that he saw colors at the same time that he perceived the sound; and so well did he perceive the color, that, when he stopped his ears, he could divine by it how loud a sound the fork had produced. Dr. Nussbaumer was afterward able to add to his own observations nearly identical ones made by a medical student in Zürich. Later on, M. Pedrono, an ophthalmologist of Nantes, observed the same peculiarities in a friend. In these cases musical sounds gave sensations varying the color according to the instrument played upon, thus showing the dependence of the phenomenon upon the timbre. For instance, the saxophone gave yellow sensations; the clarionet, red; the piano, blue. When numbers and words were used, the following results were obtained in cases mentioned in an article, 'Color of Words,' by E. A. Newell (*Popular Science Monthly* for December, 1887): 1, black; 2, light cream; 3, dark cream; 4, brownish red; 5, black; 6, tan-color or cream; 7, greenish black; 8, dark straw; 9, mud-color; 10, black; 11, black and straw; 12, light cream; 13, dark straw-color; 14, light brown. Following are some familiar names, and the color of each, and also the letters of the alphabet: Mary, dark red; Abbie, tan; Lucy, dark blue; Richard, light gray; Atlanta, steel-gray; Charlotte, light red; Claire, light blue; Newcomb, dark red; Lincoln, black; Morse, brown; A, light straw; B, gray; C, tan; D, blue; E, black; F, black; G, light straw; H, red; I and J, black; K, blue; L, black; M, brown; N, dark blue; O, light red; P, light green; Q, blue; R and S, light straw. Henri de Parville, in the *Popular Science Monthly* for August, 1883, and previously in *Le Monde de la Science et de l'Industrie*, says, "Popular expressions are often significant. 'I saw three dozen lights of all colors,' or some such expression, may frequently be heard from persons who have received violent blows on the head or face. Under the influence of shocks of this kind, the eye seems to see infinite numbers of sparks. Shocks of a certain class impressed upon the nervous system seem to have the faculty of producing phenomena of light. There are persons endowed with such sensibility that they cannot hear a sound without at the same time perceiving colors. Each sound to them has its peculiar color: this word corresponds with red, and that one with green; one note is blue, and another is yellow."

ETHNOLOGY.

Tattooing.

MISS A. W. BUCKLAND, in the *Journal of the Anthropological Institute* of Great Britain, publishes a study of the distribution of the custom of tattooing. Although her list of tribes who practise this custom might be considerably increased, some of the results of her study are of great interest. She distinguishes two methods of tattooing. In the one, cuts are made in such a manner as to leave a scar; in the other, patterns are pricked out, and coloring-matter is rubbed into the wounds. According to Miss Buckland, the former method, which she calls 'gashing,' is confined to Africa (excepting Egypt), some parts of southern Europe, and Australia, including a few of the neighboring islands. Tattooing, in the proper sense of the word, is practised in Polynesia and all over the American continent. The most beautiful patterns are found in New Zealand and among the lower classes of Japan. The author calls attention to the widespread custom of marking the chins of women as denoting marriage. The distribution of the custom of tattooing is more fully illustrated in Gerland's excellent ethnological maps, which are being published in Berghaus's 'Atlas of Physical Geography.' He distinguishes between tribes tattooing both sexes and those tattooing the women alone, which is most extensively practised by the natives of Arctic America and the east coast of Asia. The student of this problem will find material of the greatest value in W. Joest's work on tattooing, gashing (or, as he calls it, 'drawing by means of scars'), and painting the body. The plates, which form the most important part of the work, are beautifully done, and deserve the more praise, as they must be considered absolutely reliable. Joest emphasizes justly that it is necessary to take the most painstaking care in reproducing ornaments of this kind. It is necessary for the artist to understand the intentions of the native tattooer or draughtsman, in order to render his work correctly. As this precaution has frequently not been taken by travellers, many drawings of works of native art are mere caricatures. Fortunately the necessity of the greatest care in making collections of this kind is well understood at present. Joest arrives at the conclusion that tattooing has no connection whatever with the religion of the tribes who practise it, but that it is chiefly ornamental. Miss Buckland is of a similar opinion. She says that tattooing is generally ornamental, and that it seems to be in the men honorable, denoting bravery in battle. Tattoo-marks are, as a rule, geometric designs. There are only a few tribes known among whom conventionalized animal forms are used, denoting the totem of the bearer. Among these are the Haida of the Queen Charlotte Islands, the tattoo-marks of whom were first described by Swan. Several of their neighbors practise the same custom. Joest's book contains a partial bibliography of this subject. The etchings and plates which accompany his book refer principally to Melanesia and Polynesia; but, besides this, tattooing from Tunis, a beautiful specimen from Japan, and several from Central Africa and Burmah, are given.

A RECENT DISCOVERY IN EGYPT. — Prof. A. H. Sayce, in the August number of the *Contemporary Review*, describes an archæological discovery of great interest, made recently in upper Egypt, where a large collection of clay tablets, inscribed with cuneiform characters of a cursive Babylonian form and in the Babylonian language, have been found at Tel el-Amarna. They consist, for the most part, of letters and despatches sent by the governors and kings of Palestine, Syria, Mesopotamia, and Babylonia, to two Egyptian monarchs, Amenophis III. and Amenophis IV. Five of the letters are from Babylon, the date being about B.C. 1430, which approximately fixes the period to which the reign of Khu-en-Aten must be assigned; but the largest number refer to the mother of the latter, who was the daughter of the King of Naharina. This place is proved by the tablets to be situated on the eastern bank of the Euphrates. The unexpected revelation of active literary intercourse from one end of the civilized East to the other, in the century before the date assigned by Egyptologists to the Exodus, is likely to produce a revolution in our conceptions of ancient Oriental history. It

is needless to point out what an interest it possesses for the student of the Old Testament, or what important bearings it is likely to have upon the criticism of the Pentateuch. The most unexpected part of the discovery is the fact that the medium of literary correspondence was the Babylonian language and script. It is true that here and there we come across evidences that the writers were not of Babylonian origin, as when the king is called a 'sun-god,' in accordance with Egyptian ideas, or when the first personal pronoun is expressed by the Phœnician *anuki* instead of the Assyro-Babylonian *anaku*. But the language of Babylonia is generally correctly written, and the scribes show that they had acquired a very thorough knowledge of the complicated cuneiform syllabary. It is evident not only that good schools existed throughout western Asia, but an acquaintance with Babylonian literature as well. We can now explain the presence of the names of Babylonian deities, like Nebo or Rimmon, in Canaan, as well as the curious resemblances that exist between the cosmologies of Phœnicia and Babylonia. Perhaps the most important result of the discovery is the evidence it affords us that some parts, at any rate, of the books preserved in the libraries of Canaan, were written in cuneiform characters, not upon papyrus, but upon imperishable clay. There is therefore some hope that when the excavator is able to exhume the buried relics of cities like Tyre or Kirjath-Sepher, 'the town of books,' he will find among them libraries similar to those of Assyria or Babylonia. Not only do we now know that the people of Canaan could read and write before the Israelitish conquest, we also know that they wrote upon clay. The 'scribes' mentioned in the Song of Deborah (Judges v. 6) have become to us living realities. The discontinuance of the old literary intercourse, and of the international language and script which accompanied it, must have been due to the advance of the Hittites and their long wars with the Egyptians, followed by the Israelitish invasion of Palestine. Western Asia was for a time a scene of bloodshed and disorder; Egypt had fallen into decay, and the cultured populations of Canaan were struggling for life and home. On the north were the Hittite tribes; on the south, the children of Israel. When order began to reign again, the influence of Babylonia had passed away, and its cumbrous syllabary had been superseded by the simple Phœnician alphabet. The date at which this was introduced into Phœnicia has now to be fixed by the progress of archæological research.

ELECTRICAL SCIENCE.

Disruptive Discharges and their Relation to Underground Cables.

THE paper read by Mr. E. G. Acheson before the National Electric-Light Association, on the above subject, was the most valuable contribution to our knowledge of underground cables that was given at the last meeting of the association. The object of the experiments described by Mr. Acheson was to find out under what circumstances the insulation of a wire carrying a high-tension current would be pierced by a spark. Some previous experiments on the discharge between points in air led to the equation

$$d = \frac{(\text{E.M.F.})^3 \times (\text{Capacity})}{a},$$

where d is the spark-length, and a is a constant for the dielectric, the capacity being expressed in micro-farads. For air, a was taken as 135, and d was expressed in inches. As the conditions which actually occur in practice are not discharges between two points, but between the cylindrical surface of the wire and some point outside the insulation, experiments were made to determine the value of a with this arrangement and with different dielectrics. The results give, in general, a greater value of a than when the points alone are used.

Dielectric.	Spark between.	a
Air	Points	135
Air	Point and wire	263
Paraffine and cotton	Point and wire	5,822
Ozite and cotton	Point and wire	7,759

To find what effect cracks in the insulation would have, Mr. Acheson took a broken plate of glass, the two parts of which were held firmly together. With a high electro-motive force, there was no discharge between two points on opposite sides of the glass when the solid part of the plate was between; but, when the points came abreast the crack, there was a spark. Another interesting experiment showed that a disruptive discharge, due to the breaking of a high-tension cable, would rather go through the insulation than through an electric arc.

To avoid any chance of a disruptive discharge through the insulation of the cable, especially if the latter be lead-covered, Mr. Acheson suggests that a wire be twisted around the outer lead covering, and the point be brought near to the bared surface of the conductor, the distance between them being adjusted until the discharge would pass between the conductor and the point rather than through the insulation.

In concluding his paper, the author says, "It is safe to predict, that, the disruptive discharge being provided for, little or nothing more would be heard of the much-talked-of pin-holes in the lead, and the moisture-absorbing terminals; the undergrounding of arc-light cables would become a thing of certainty, and our municipal governments relieved of a great bugaboo.

THE RECHNIEWSKI ALTERNATE-CURRENT MOTOR. — The adaptability of alternating currents for distributing light over an extended area has led a number of inventors to attempt to devise an electric motor that can be used on such circuits. The motor of Mr. Tesla, which has been described in this journal, is one of the most ingenious attempts in this direction, although there is yet considerable doubt as to its efficiency and regulating properties and its adoption would necessitate a complete change in the present method of distribution. It has been known ever since any attention was called to the subject, that an ordinary series motor would work on an alternating-current circuit, and Mr. Kapp has pointed out that a condition of maximum output is that the self-induction and counter electro-motive force of the motor should be equal. M. Rechniewski's motor is of the inverted Edison type, the field-magnets and armature-core being both built up with thin iron plates. The armature is of the drum type, and is large compared with the field-magnets. No data as to the performance of the motor are obtainable, but the following figures, taken from the *London Electrician*, give some idea of its construction: —

Volts at terminal	115
Current in ampères	100
Revolutions per minute	1,400
Diameter of armature	8 in.
Peripheral velocity in feet per minute	2,800
Weight of iron in field	440 lbs.
Weight of iron in armature	108 lbs.
Section of iron in field	42.5 sq. in.
Section of iron in armature	33.5 sq. in.
Induction in armature	3,700,000 lines.

The motor is not self-regulating, but it can be governed in the same way as some of the continuous-current motors.

MEASUREMENT OF ILLUMINATION. — M. Mascart has invented a photometer that enables him to compare the illumination produced by two sources of light. The standard lamp illuminates a plate of ground glass, an image of which, formed by a lens, is thrown after two reflections on a second plate of ground glass, called the 'test-glass.' The general diffused light of the room to be tested illuminates a translucent screen, the rays emitted from which are reflected at an angle of forty-five degrees, and fall on the other half of the test-glass. The light from either source can be more or less cut off by sectors. In lighting similar rooms of different sizes, it would appear at first that the source of light should vary in intensity with the square of the dimensions. It is found in practice, however, that the quantity of light varies as the cubic contents of the room. We may, from a consideration of the limiting distance at which a source of light ceases to be effective, get an idea of mean illumination. If, for instance, the limiting distance is ten metres, and the mean illumination one carcel at one metre, then the illumination should be .16 of a carcel per cubic metre. Comparing the illumination of public buildings during this century leads to the conclusion